DOCUMENT RESUME

ED 239 887 SE 043 843

AUTHOR Zesaguli, Josie
TITLE Reproducing by Flowers and Seeds. Teacher's Guide. Unit E2. ZIM-SCI, Zimbabwe Secondary School Science Project.
INSTITUTION Ministry of Education and Culture (Zimbabwe).; Zimbabwe Univ., Harare. Science Education Centre.
PUB DATE Dec 81
NOTE 49p.; For study guide, see SE 043 842; for related documents, see SE 043 827-859.
AVAILABLE FROM Univ. of Zimbabwe, P.O. Box MP 167, Mount Pleasant, Harare, Zimbabwe.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Botany; Cytology; General Science; *Plant Growth; *Reproduction (Biology); *Science Activities; Science Education; *Science Experiments; Science Programs; Secondary Education; *Secondary School Science; Teaching Methods; Units of Study
IDENTIFIERS *Zimbabwe Secondary School Science Project

ABSTRACT

The Zimbabwe Secondary School Science Project (ZIM-SCI) developed student study guides, corresponding teaching guides, and science kits for a low-cost science course which could be taught during the first 2 years of secondary school without the aid of qualified teachers and conventional laboratories. This teaching guide, designed to be read in conjunction with the related student guide, includes instructional strategies, lists of required materials, laboratory procedures, and other information for activities and experiments in a unit in which students: (1) identify plant sex cells and sex organs; (2) study the mechanisms of pollination and fertilization; (3) investigate the development and dispersal of seeds and fruits; and (4) observe the life cycles in some plants and animals. Because the development of concepts in this unit has been carefully designed, it is essential that all experiments, activities, and discussions be done in the exact order throughout the unit. Each section in this guide corresponds to a given section in the student study guide. (JN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED239887

ZIM–SCI

ZIMBABWE SECONDARY SCHOOL SCIENCE PROJECT

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

✓ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Ministry of Education and Culture

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

SE 043 843

TEACHER'S GUIDE UNIT E2

Reproducing by Flowers and Seeds

UNIVERSITY OF ZIMBABWE
AND MINISTRY OF EDUCATION AND CULTURE

This teaching material is produced jointly by the Science Education Centre, University of Zimbabwe, and the Ministry of Education and Culture.

Copyright is reserved jointly to the University of Zimbabwe and the Ministry of Education and Culture.

None of the material may be produced in whole or in part, by any means, without written permission of the Director, Science Education Centre and the Secretary, Ministry of Education and Culture.

Zim-Sci Team: Alan Dock (Project Leader)
Peter Dube
Sue Stocklmayer
Bunty Hosking
Josie Zesaguli
Thoko Chitepo
Gift Jambaya
Mary-Ann Lobb

Main Writer of this Unit: Josie Zesaguli

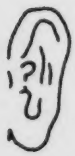
Acknowledgement: We are grateful for the ready cooperation and assistance we have received from the Audio Visual Department of the Ministry of Education and Culture in the preparation of art work.

December, 1981.

The following symbols will be used to indicate the points in the lesson at which teacher activity is particularly important. These symbols also appear at the corresponding points in the pupil study guides.

Practical work. The necessary instructions for each experiment will be given to you when you see this symbol.

Written exercises for the pupils. If possible these should be put on the blackboard before practical work begins so that the pupils can see what to look for.



Teacher information. The pupils will need extra guidance at these points. The information they will need from you is given where you see this symbol.

This symbol appears at a point where it is necessary for pupils to think over what they have done in the past few lessons. Set aside a period for this review activity. Encourage the pupils to read over their notes and the study guide section which they have just covered. It may be helpful to ask them to write a summary too.

The following symbols which appear only in the Teacher's Guide are used to indicate important points for you the teacher.

Take note of an important point.

This symbol indicates a preparation of apparatus which should be done well ahead of time. Please read these notes carefully and carry out the instructions well in advance.

We have placed this symbol next to experiments where we feel there may be a possible danger. Please read the section carefully so that you know about the particular danger in that experiment. It would also be wise to refresh your memory on the appropriate safety or first-aid procedures described in the Zim-Sci Handbook.

UNIT E2 : TEACHER'S GUIDE

CONTENTS

	Page
Aims of this Unit	1
Special information	2
Finding the male sex cells in a flower	4
Looking at plant female sex cells	7
Comparison of plant and animal sex cells	10
Looking at insects near flowers	12
Insect pollination	14
Advantages of cross-pollination	16
Prevention of self-pollination	16
Looking at dull flowers	19
What happens after pollination	22
What happens when the pollen tube grows	23
Development of the seed	26
Looking at plant seeds	27
Looking inside the seed	28
Changes in the ovary after fertilisation	32
Looking at fruits	34
Puzzle Picture	36
Investigating dispersal of fruits and seeds	39
Life cycles	41

AIMS OF UNIT E2

When you have completed this study unit pupils will be able to:

1. Identify and draw plant male and female sex cells.
2. Identify, draw and label the male and female sex organs of a plant.
3. Define pollination.
4. Explain the differences between self-pollination and cross-pollination.
5. Describe the differences between insect-pollinated and wind-pollinated flowers.
6. Describe the advantages of cross-pollination.
7. Explain how plants prevent self-pollination.
8. Explain how fertilisation occurs in plants.
9. Describe what is inside a seed. Identify the main parts of a seed.
10. Define dispersal of fruits and seeds.
11. Explain the importance of dispersal.
12. Describe the different features which fruits and seeds have which help in their dispersal.
13. Draw a life-cycle of a named plant.

UNIT E2 : TEACHER'S GUIDE

In this Unit your pupils will learn how flowering plants reproduce. They will:

(i) identify plant sex cells (ovules and pollen grains);

(ii) identify sex organs (pistils and stamens);

(iii) study the mechanism of pollination (types, agents and the different adaptive characteristics in flowers for self-and cross-pollination);

(iv) study the mechanism of fertilization;

(v) investigate the development and dispersal of seeds and fruits;

(vi) observe the life cycles in some plants and animals.

N.B.

1. Because the concept development has been carefully designed in the pupil study guide, it is essential that all the experiments, discussions and written exercises be done in the order in which they appear.

2. Your local environment will be the source of all of the specimens your pupils will need to study. In order to be sure that you will have the correct specimens for your pupils when they need them, we strongly advise you to spend a little time exploring the area around your school and identifying sources of materials.

This symbol in your teacher's guide indicates where local material must be found in advance of a lesson.

SPECIAL NOTE

N.B.

Units E2 and E3 must be done at the same time. That is, your pupils should observe the various life cycles of the different animals described in Unit E3 while doing work in Unit E2.

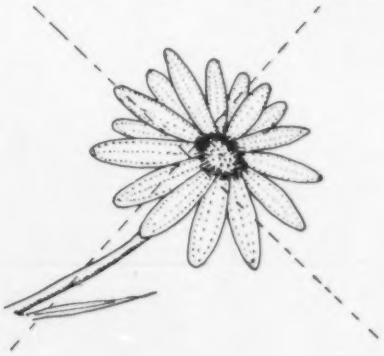
Page 3 EXPERIMENT 1 : Finding the male sex cells in a flower

Each pair of pupils will need:

- a simple flower
- a bicmount
- a bioviewer
- a scalpel or razor blade
- a handlens

P

The flowers should be collected before the lesson.
Examples of some simple flowers are:
jacaranda; petunia; lilies; hibiscus;
bean and pea flowers.
Other flowers which are composite (complicated), e.g. daisy, marigold, etc. will be confusing at this early stage and therefore should not be used.

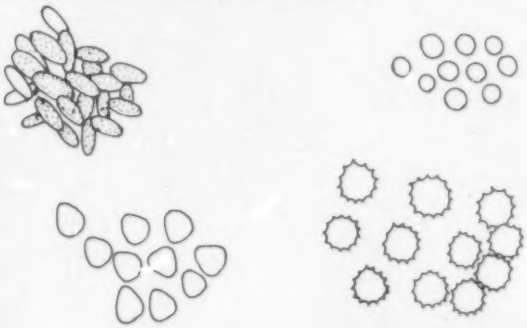


A composite flower

A simple flower (jacaranda) cut open

It will be better to have quite a variety of simple flowers so that the pupils can see the differences in the shapes, sizes and arrangement of stamens and the pollen grains.

After the pupils have looked at their pollen grains, using biomounts and the bioviewer, show them at least two different pollen grains of two different flowers under your microscope. Pupils will notice that pollen grains have different shapes and sizes. The pollen grains may look like these:



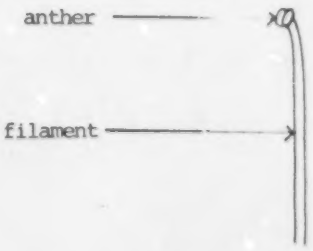
Pollen grains from different flowers.

N. B.

It is very important in science that your pupils should learn to draw from what they are actually seeing under a microscope.

When the pupils are looking at the stamen you might like to suggest they put it in a biomount and observe it through the bioviewer.

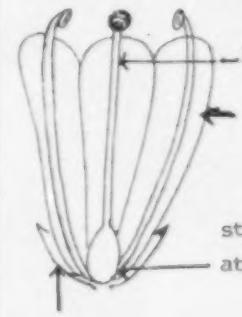
The stamen will look something like this:



A stamen

Please turn over

Stamens in different flowers are attached differently. Some are attached at the base of the flower. Some are attached on the brightly coloured petals' bases. Others, like in the hibiscus, are attached to a tube around the style. Make sure the pupils observe these different arrangements in the flowers collected. Here are sketches of some of them.



(hibiscus flower)

The pupils' flowers can be used for Experiment 2 if it is done in the same lesson. But they should find fresh ones if Experiment 2 is done days after Experiment 1.

Page 4

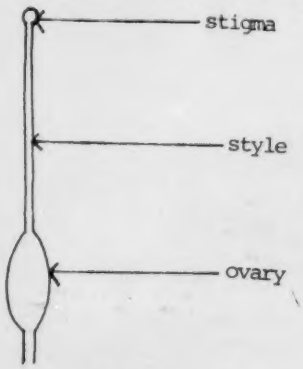
EXPERIMENT 2 : Looking at plant female sex cells

1. Your pupils will need the same apparatus as they used in Experiment 1.

2. Tell the pupils to remove the outer parts of the flower carefully, layer by layer, in order to expose the pistil. The outer layer is made up of small green leaves called SEPALS which protected the developing flower in bud. The following outer layer is made up of brightly coloured parts called PETALS. These attract the insects.

   The pistil is the plant female sex organ at the centre of the flower.

3. The correct labelling of the pistil is:



A pistil

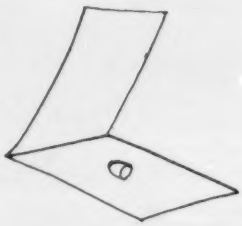
4. In a large ovary, as of the hibiscus flower, your pupils should be able to see the ovules using their handlenses held over the cut surface.

Please turn over

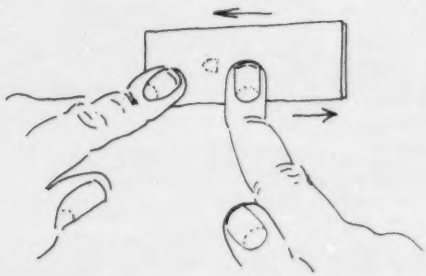
5. In the smaller ovaries the pupils will have to squash them between the micromount and use the bioviewer to see the ovules.

Here is a flow chart for making a squashed ovary.

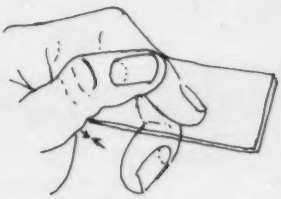
(a) place ovary between the acetate folder



(b) fold over the micromount and place on the table

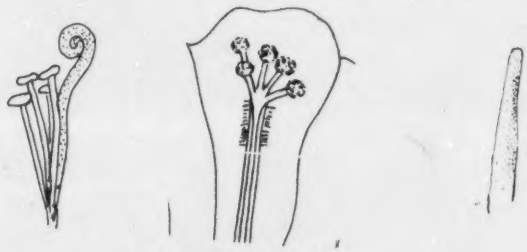


(c) squash by moving the thumb across the ovary to and fro until you have spread the ovary thinly between the micromount



(d) push the micromount into the bioviewer and find the ovules, which will be seen as very small round balls.

6. The shape and size of the stigma varies in different flowers. Pupils should draw the pistil in their own flower. Go round and check this as they draw. Some stigmas are not swollen at all.



Different shapes of stigmas

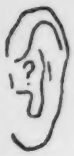
Exercise 1

1. The plant male sex organ is called the .....
2. The head of the stamen is called the .....
3. The anther produces the male sex cells called .....
4. The plant female sex organ is called the .....
5. Three parts of the pistil are ....
6. Female sex cells called ..... are produced and protected by the .....

Answers to Exercise 1

1. stamen
2. anther
3. pollen grains
4. pistil
5. stigma, style and ovary
6. ovules, ovary

Page 6



In what ways are plant sex cells like animal sex cells?

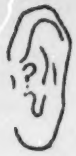
Here is some information you can use when discussing this question.

1. Animal eggs are larger than the sperm. Similarly, plant ovules are bigger than the pollen grains.

   Your pupils should be able to come out with this fact because ovules were easily observed using a handlens and the bioviewer which magnifies things only about eight times, whereas pollen grains were only seen clearly under the microscope whose magnification is much larger.

2. A second similarity is that the ovule and the pollen grain each carry half of the set of instructions as did the egg and the sperm. They must fuse to get a complete set of instructions to produce a new organism.

3. Both the egg and the ovule are large because they contain food.



The differences between plant sex cells and animal sex cells are:

1. Generally, animal sex cells are found in two different organisms. A male organism produces male sex cells (sperm) while a female organism produces female sex cells (ova). In plants, most flowers have both the male and female sex cells produced in the same organism.

   There are, however, exceptions in both cases.

2. Animal male sex cells (sperm) have tails which they use to swim actively to reach the eggs (ova). But in plants the male sex cells (pollen grains) have no tails. They need an outside agent, like insects, wind and water, to enable them to reach the ovules. This important concept is dealt with later in the Unit and should not be emphasised at this point.

Exercise 2

Comparison of plant and animal sex cells

Copy these sentences and fill in the blanks.

1. Both plant and animal sex cells carry ..... set of instructions needed to produce a new organism.

2. Animal sperm have ..... which are not present in plant pollen grains.

3. The size of an ovule is ..... than the pollen grains because it contains ..... food.

Answers to Exercise 2

1. half
2. tails
3. bigger, more

Page 7

EXPERIMENT 3 : Looking at insects near flowers

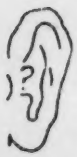
1. The pupils must find a tree with flowers or a garden with lots of flowers. Warn your pupils not to be noisy so that they do not disturb the insects.

2. The pupils can easily observe the caught insects held inside their plastic insect catching net.

Using their handlenses they should be able to observe the following:

(a) that the insect's body and legs are covered with hairs;

(b) that the hairs are covered with a yellow powder which is the pollen grains.



This means that as the insect enters the flower, it will have to rub against the anthers because the flower parts are so close together. As the insect emerges, its body may rub against the stigma which is sticky. Some of the pollen grains from the hairs may stick to the stigma. The insect may rub on more anthers as it leaves thus collecting more pollen grains which will be rubbed against the stigma of the next flower it visits. In this way pollen is transferred from the anthers to the stigma. This process is called pollination. There are two types of pollination.

Self-pollination when the transfer of pollen grains is from anthers to the stigma of the same flower.

Cross-pollination takes place when pollen grains are transferred from anthers of one flower to the stigma of another flower of the same kind.

Exercise 3

1. Name the flowers you saw the insects visiting.

2. Name at least one insect you saw visiting the flower.

3. The body and legs of the insects have ..... which collect pollen from the flower.

4. The sticky ..... received pollen from the insect.

5. The process of transferring pollen grains from anthers to stigmas is called .....

6. If pollination takes place within the same flower then it is called .....

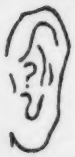
7. ..... takes place when pollinating takes place between flowers of the same kind.

Answers to Exercise 3

1. examples will vary . Local names are acceptable.
2. bees, butterflies
3. hairs, anthers
4. stigma
5. pollination
6. self-pollination
7. cross-pollination

Page 8

Insect-pollination



The insects do not know that they are pollinating nor do they set out to do so. What is actually happening is that the insects are going from flower to flower in search of NECTAR. This is a sugary liquid made by NECTARIES found at the base of the flowers. This nectar is used to make the honey which we all love to eat.

The position of the nectaries makes the bees go deep down into the flower in order to reach them as shown in the diagram in the Study Guide E2, page 7.
So flowers are being pollinated by 'accident' while the insects are looking for food (nectar). Because the insects have to look for nectar, nature has made sure that this accident is always happening!

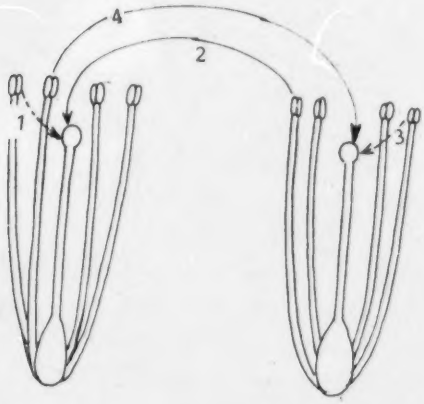
Exercise 4

This is an interesting puzzle. Let the pupils copy these two sketches of two flowers from the board.

Flower A

Flower B

1. Draw the movement of the pollen grains, showing four possible ways that these two flowers can be pollinated. (To make this clearer, ask them to use arrows showing from where the pollen grain comes and to where it goes.) The final four pathways are indicated below.



Flower A Flower B

This means that:

(a) each flower can be self-pollinated, shown by arrows 1 and 3 in flower A and flower B respectively;

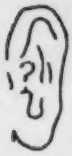
(b) two flowers can cross-pollinate each other. This is shown by pathways 2 and 4.)

2. Copy these sentences and fill in the blanks.

"Insects visit flowers which produce .....
They are attracted by ..... and .....
The insects' bodies and legs are covered with .....
The pollen grains which are ..... are caught or trapped by the hairs on the insect's body as it enters the flowers.
As the insect, leaves the flower, it may rub against the ..... leaving some ..... there."

Answers to Question 2 of Exercise 4

nectar; scent and bright colour; hairs; sticky; stigma; pollen grains.

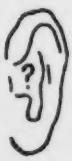


ADVANTAGES OF CROSS-POLLINATION

Cross-pollination is preferred in nature because it brings about the mixing of characteristics from the two crossed plants. This results in a wide variety of plants of the same type which are stronger.

Farmers deliberately cross-pollinate plants by covering the flowers to prevent insects visiting them. Then the farmer artificially pollinates the flowers with pollen grains from a selected plant of the same type which has favourable characteristics. For example, Type A of maize grows quickly but gives very small seeds on the cob. Type B maize grows slowly and gives large maize seeds. When Type A and B are cross-pollinated a hybrid is produced which grows at a moderate rate and gives good-sized seeds. In this way varieties are produced, e.g. different shades of flowers; different flavours of the same fruit; etc. Production of varieties is practised not only by farmers to grow better food crops, fruits, vegetables, tobacco, timber and very beautiful flowers, but also to breed high grades of animals.

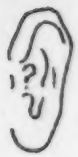
So, careful cross-pollination enables us to choose the kinds of plants we want in terms of rates of growth, types of flowers, types of fruits, resistance to diseases, etc. Plants can also be produced to suit types of soil and available rainfall.



PREVENTION OF SELF-POLLINATION IN FLOWERS

Your pupils must by now be wondering how nature attempts to bring about cross-pollination and not self-pollination. So for this lesson, bring flowers of maize, paw paw, pumpkin, etc.

Flowers which have either the pistil or the stamens only are called unisexual flowers. They have one set of sex organs only. Such flowers can only be cross-pollinated.



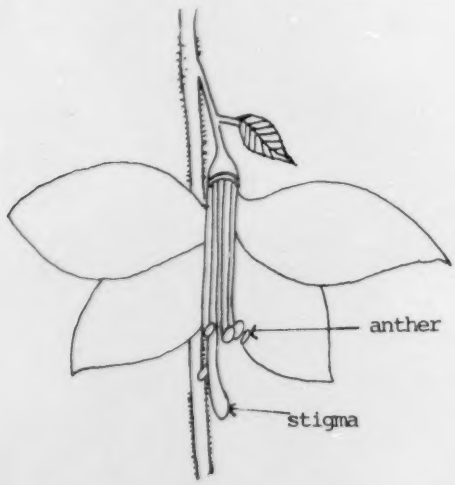
Flowers with both the pistil and the stamen are called bisexual flowers.

Some bisexual flowers can either be self-pollinated or cross-pollinated depending on the arrangement of the pistil and the stamen.

Show the class a hibiscus flower and a jacaranda or lily or petunia flower.

The class should be able to see that no self-pollination is likely in the hibiscus with the stigmas above the anthers. The insect usually lands on the stigma and walks over the anthers towards the nectaries. When it has collected the nectar, it flies straight out of the flower. This flower is a very open one which gives the insect a free path out. In the jacaranda, self-pollination is possible.

Interestingly enough, some flowers can fool you because the stigma may be above the anthers, but on the plant the flowers may be held upside down so that self-pollination may be possible as shown in this sketch below.



Let the children explore the local plants and see if they can find examples of these. The pupils do Exercise 5.

8

Exercise 5

Put this table on the board for the pupils to copy.

Name of the flower	Pistil present or not present	Stamen present or not present	Pistil higher or lower than the stamen	Type of pollination possible

1. Copy the table.

2. Go outside and examine closely at least 5 different flowers.

3. While you are observing, fill in the table for each flower and decide whether the flower can be self-pollinated or cross-pollinated or both. Include a sketch of the flower as it hangs on the plant

Page 10

EXPERIMENT 4 : Looking at dull flowers

After looking at dull flowers, such as those of grasses and maize, the pupils should come up with some characteristics of maize or grass flowers such as:

1. The flowers are small and many. They are found on the top of the plant.

2. They are dull and have no scent, therefore do not attract insects.

3. Pistils and stamens are many and they hang outside the flowers. They move easily in a breeze.

4. They produce pollen grains which are small, dry and light so that they can easily be blown away by the wind. The wind does not blow them all to the stigma of a suitable flower, so many pollen grains must be produced to make up for those that are lost.

5. The stigmas are thin threads which form a net to trap the pollen grains in the wind. All dull flowers are wind-pollinated.

6. Therefore, wind is an agent of cross-pollination.

Exercise 6 (Part 1)

Fill in the blanks.

Characteristics of Dull Flowers

1. Grass/maize flowers have a ..... colour.

2. They do not attract insects because they do not have ..... and .....

3. The ..... and ..... hang outside the flower.

4. Their pollen grains can easily be carried away by the wind because they are ..... and .....

5. The ..... is divided up into threads which provide a larger surface to trap the pollen grains in the wind.

6. Dull flowers are usually ..... -pollinated flowers.

Answers to Part 1 of Exercise 6

1. dull
2. scent, colour nectar
3. stamens, pistils
4. small, light, dry, etc-
5. stigma
6. top
7. wind-

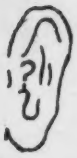
Your pupils must now be able to compare the characteristics of insect-pollinated and wind-pollinated flowers.

Exercise 6 (Part 2)

Summary Table

Copy the headings on to the board. Fill in the first column (items 1-8). Your pupils can then copy and complete the table in their books. Possible answers have been filled in for you.

Characteristic	Insect-pollinated flower	Wind-pollinated flower
1. Size of flower	large	very small
2. Flower colour	very brightly coloured	dull coloured
3. Smell/scent	have scent	no scent
4. Pollen grains (size, number, etc.)	few, large and sticky	many, small and light
5. Stigma (size, number, shape and position)	large, usually on big knob on the inside of the flower.	many, thin or feathery threads, hang outside the flower
6. Stamen (size, number and position)	short, strong, inside flower	long, thin, many hang loosely outside flower
7. Nectar	produced	not produced
8. Movement caused by the wind	little movement	shakes freely and releases the pollen grains



Page 12

WHAT HAPPENS AFTER POLLINATION?

Before the next lesson try and grow pollen tubes using pollen grains from different flowers. This is a difficult exercise, but it will help your pupils if you succeed in showing them a pollen tube growing. The idea is to take ripe pollen grains and shake them onto the surface of a sugary liquid. After a short time, pollen tubes may grow.

To prepare the sugar solution, which takes the place of the sugar liquid on the stigma:

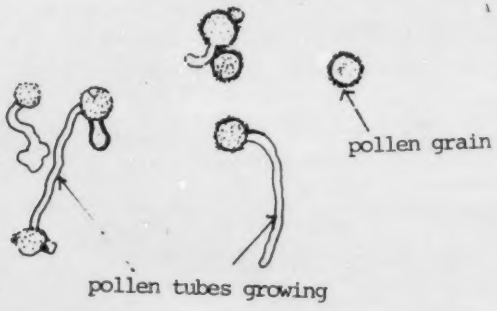
1. Dissolve 10g sugar into 100ml of water. This will make a 10% sucrose solution.

2. Put 2 drops of this solution on some clean slides. (The number of slides depends on the number of flowers to be tried.)
   If possible, try pollen from aloes and hibiscus and lilies.

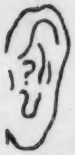
3. Shake pollen grains from each flower on a separate slide and label.

4. Leave for some time - at least for half an hour or more. Slides should not be allowed to dry out

5. Look under the microscope and see if your pollen tubes have grown like those shown on this diagram.



Page 12 (contd.)



What happens when the pollen tube grows

1. The stigma produces a sugary liquid which is absorbed by the pollen grains.

2. The pollen grains grow out into pollen tubes.

3. Each pollen tube has the male sex cell nucleus near the tip.

4. The pollen tubes grow downwards between the cells of the style.

5. The movement is like the way water finds its way between soil particles until it gets to the bottom.

6. Thus, pollen tubes reach the ovules in the ovary as is illustrated in the study guide.

7. No pollen tubes will grow if the pollen grains are from a different unrelated type of plant, that is, of a different species. A species is a group of related organisms which can reproduce among themselves. For example, a pumpkin's pollen grains will not develop into pollen tubes on the stigma of a water melon, so pumpkins and water melons must belong to different species.

Emphasise to your pupils that:

(a) An ovule is fertilised when the pollen grain nucleus fuses with the ovule nucleus.

(b) When an ovule is not fertilised it will not develop into a seed. A seed is a ripened ovule. Your pupils may have seen gaps on maize cobs or

Please turn over

in the pods of beans. These are where ovules were not fertilised.

(c) An ovule can only be fertilised by <u>one</u> pollen grain just as only one animal sperm nucleus can fuse with the egg nucleus.

Now put <u>Exercise 7</u> on the board.

<u>Exercise 7</u>

1. After pollination the pollen grains feed on the .....

2. The pollen grains grow into .... which grow downwards into the .....

3. Draw a sketch showing pollen grains growing down the pistil and label on the diagram the:

   (a) stigma
   (b) style
   (c) ovary
   (d) ovule
   (e) pollen tube

4. An ovule is fertilised when the pollen grain male sex nucleus ..... with the female sex nucleus.

5. A fertilised ovule develops into a .....

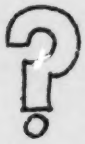
<u>Answers to Exercise 7</u>

1. sugary liquid on the stigma
2. pollen tubes, ovules
3. sketch as in study guide on page 12.
4. fuses/joins
5. seed

Put aside a whole lesson for pupils to read through their study guides and notebooks.

Page 13

HOW MUCH DO YOU KNOW?

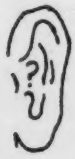


Answers

1. pollen, ovules
2. nectar, scent, bright colours, etc.
3. insect-pollinated flowers
4. smaller, lighter or drier
5. bean, jacaranda - accept any local names as examples
6. maize, grass, wheat, etc.
7. inside, outside
8. cross-pollination, self
9. will not

Page 14

DEVELOPMENT OF THE SEED



The most important point to be stressed here is that unlike the animal embryo which continues to grow after fertilisation, the plant embryo stops growing for a while when the seed is fully developed. It will remain sleeping, i.e. dormant, protected from damage by the seed coat (TESTA), until it is ready to grow into a new plant. This is called germination. Germination will only happen when the seed is given some moisture, air and warmth.

Page 15

EXPERIMENT 5 : Looking at plant seeds

N.B.

Please note that there is an error in the study guide on page 15. Drops of iodine are NOT required for this experiment.

Your pupils will need:

a ruler

handlenses

a pin

You will give each pair 4 beans of which

one will be a dry one

one has been kept in water for 1 day

one has been kept in water for 7 days

one has been kept in water for 14 days

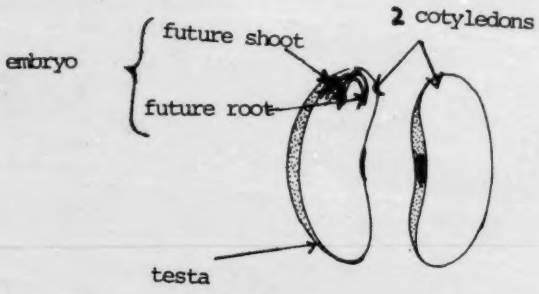
Those seeds kept in water must be wrapped in cotton wool which is kept just wet. Too much water will cause rotting of the seeds.

Before the pupils start comparing their seeds, give them this table to copy and fill as they work.

SEED	SKIN smooth, wrinkled, stretched or split	SIZE OF SEED i.e. length of C in diagram	SIZE OF EMBRYO i.e. length of E in diagram
dry seeds			
kept in moisture 1 day			
kept in moisture 7 days			
kept in moisture 14 days			

28 LOOKING INSIDE THE SEED

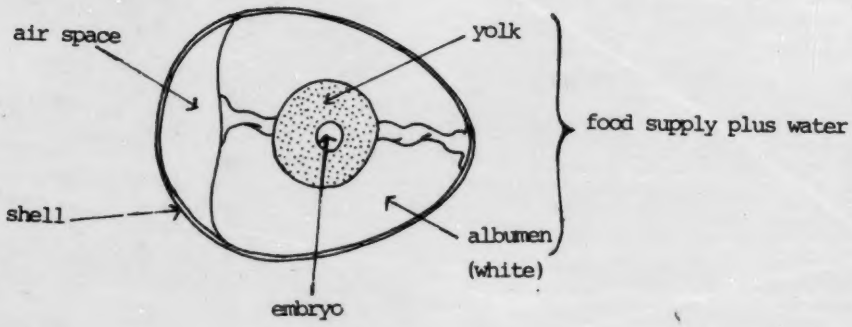
The diagram of the open seed should look something like this:



At this point, the pupils should see the similarities between the plant's seed and animal's egg. They should think about:

(a) protection
(b) food supply
(c) the relative size of the embryo in relation to the food supply
(d) conditions needed by the embryo to develop

Discuss these points, using these sketches on the board:

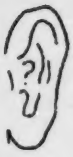


A chicken egg

OBSERVATIONS

1. Water comes out of the tiny hole (brown dot) in the soaked seeds and not in the dry ones. So this water is from the soaking.

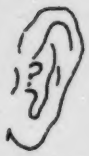
2. The skin is at first smooth then becomes wrinkled, stretched, split and torn off, as more water enters through the tiny hole seen as the brown dot. This is the MICROPYLE. The water is absorbed by the cotyledons, the swelling becoming bigger and bigger. However, the testa is not elastic. It cannot be stretched too far, so it splits. This allows the growing root to come out as it increases in size.



3. The size of the seed (length C) increases a little as water first enters. As the seedling (young embryo) starts to grow during the first week, the size of the cotyledons becomes smaller and smaller because the embryo is using up the stored food in the cotyledons. So the cotyledon size is smallest after 14 days, it is largest after 1 day, before it is used up for growth.

4. The size of the embryo (length E) is smallest in the dry seed and gradually but steadily becomes bigger and bigger as the embryo grows using up the stored food. The embryo in the dry seed does not grow because there is no water.

Page 17



After the discussion the pupils should have seen that:

(a) Embryos are protected in a plant seed by the testa. In animals which lay eggs, embryos are protected by a shell. In animals whose young are born alive, the embryo is protected by the womb.

(b) In mammals, the embryo is supplied with food from the mother through the placenta. In plants also, the embryo is attached to the ovary wall by means of a placenta. The scar on the seed shows the point of attachment. Not all the food is used straight away by the plant embryo; some of it is stored in the seed. In egg laying animals, there is no attachment to the mother. All the food is stored in the egg.

(c) All embryos are very small compared with the amount of food stored for them. This food is sufficient for the embryo until it can make or find its own.

(d) To grow, all embryos need food, water, air and warmth.

Exercise 8

1. The embryo in the seed is protected by the .....

2. Water and air enter the seed through the .....

3. A developed seed has an ..... and ..... food.

4. The process during which the plant embryo breaks out of its seed coat and grows into a plant is called .....

5. The growing embryo during germination gets its food from the .....

6. In order for seeds to germinate they need ....., ... and .....

7. As the embryo ..... in size during germination the stored food ..... in amount.

8. Write down all the ways in which a bean seed and a chicken's egg are similar.

Answers to Exercise 8

1. seed coat (testa)
2. tiny hole
3. embryo, stored
4. germination
5. stored food/cotyledons
6. water, air and warmth
7. increases, decreases
8. similarities: protection coat (shell and testa), food store (yolk and cotyledon), food supply larger than embryo, need for water, air and warmth.

Page 17

EXPERIMENT 6 : Changes in the ovary after fertilisation

Your pupils will need:

a scalpel or razor
a pencil
a handlens
their notebooks

The main points here for the pupils to see are:

1. After fertilisation, the ovary grows and the rest of the flower dies off.

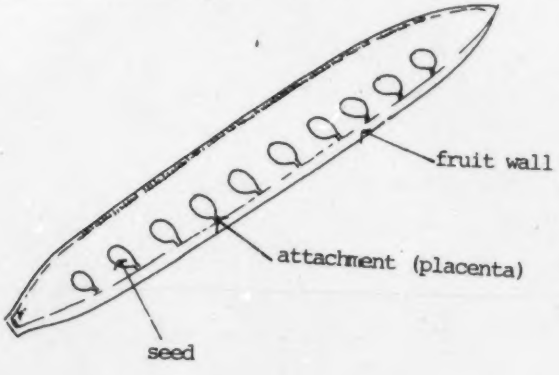
2. The ovary increases in size as the fertilised ovules develop into seeds (each with an embryo and its food supply). The food passes from the ovary wall to the developing seeds through the placenta as it does in mammals.

3. The fully developed ovary with seeds inside is called a FRUIT.

Your pupils may like to see how the seeds are attached to the ovary wall in some of these fruits:

tomato, guava, jacaranda, marula, matamba, acacia, bean, pea, petunia, etc.

They can draw the opened fruit.



Acacia pod half grown x2

N.B.

This would be an opportune moment to teach your pupils how to draw to scale. Remind them that if they magnify three times it means that not only the length but the width also should be magnified three times. This is an important skill they should develop in science. The degree of magnification must be stated with each sketch. The correct way to show this is indicated in the diagram.

Exercise 9

Fill in the blanks:

1. After fertilisation the ..... grows and the rest of the flower parts die off.

2. The ovary ..... in size because the seeds will be developing.

3. An ovary develops into a .....

4. The seeds are attached to the fruit wall by a .....

Answers to Exercise 9

1. ovary
2. increases
3. fruit
4. placenta

Page 18

EXPERIMENT 7 : Looking at fruits

In Unit A2, when pupils classified their apparatus in the basic kit they came up with different keys because the pupils were concentrating on different characteristics. Similarly, the classifications of the fruit collection may be different from one pair of students to the next, because they are looking at different characteristics. This does not matter as long as the key makes sense!

From the discussion of the different keys your pupils may come up with something like the key in Exercise 10, with the most obvious characteristic being whether they can be eaten (edible) or not (inedible).

Exercise 10

Here is a key for many different kinds of fruit. Copy it into your notebooks.

Use this key to classify five of the following fruits:
maize, tomato, fig, mango, marula, jacaranda, gumtree, acacia, orange, lemon, blackjack (tsine or ucucuza), cotton

For example:

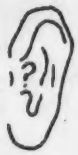
(i) maize is dry, edible and does not split when ripe;

(ii) jacaranda is dry, inedible and splits when ripe.

Page 19

Puzzle Picture

These are the points which we would like you to draw from the pupils during the discussion on the puzzle picture.



1. If fruits are left on their parent plants they will eventually fall to the ground and rot away.

2. New young plants will come up from the seeds of the rotting fruits.

3. The young plants which are called SEEDLINGS at that stage, will not grow well under this big parent plant because the seedlings will be overcrowded. There will be too many of them in one small area:
   (i) they will compete for water;
   (ii) they will compete for food since there is a limited amount of this food in that small area. You might like to give an example in terms of a variable number of family members to share some fixed amount of food - 2, 4 or 6 children sharing one plate of food;
   (iii) the seedlings will be overshadowed by the parent plant. The leaves of the parent plant will shut off the sunlight from the young plants growing under it.

Because of these reasons the young plants will not grow into healthy plants and many may die. To avoid this happening the fruits and seeds must be scattered away from their parent plants. This process of scattering fruits and seeds is called the DISPERSAL OF FRUITS AND SEEDS.

Page 20

Puzzle Pictures 1-4

The puzzle pictures in the study guide show ways in which fruits and seeds are dispersed (scattered) away from their parent plants. Allow the pupils to make their own deductions from the pictures before you discuss them.

Picture 1

The fruit wall has twisted and forcefully burst open throwing the tiny seeds to some distance from the parent plant.

Picture 2

The fruit or seeds have a tuft or head of hairs which act as a parachute and helps the blowing wind to carry them further away from the parent plant. Without the hairs the fruits or the seeds would fall very near the parent plant.

Picture 3

This shows a person picking some fruits or seeds. He will probably throw them away some distance from the parent plant (tsine or ucucuza). Such fruits and seeds have hooks by which they cling on to the fur and clothing of animals and people. You might let the children use their bioviewers and biomounts or handlenses to find these hooks.

Picture 4

This shows an animal (in this case a bird) eating some fruits which have small seeds inside. The seeds are swallowed together with the fruit flesh. Their seed coats are so tough that the seeds pass through the gut without being broken down (digested). These seeds will be passed out as undigested food at some place away from the parent plant.

In all these cases, if the seeds are dispersed to places where the conditions are favourable, they will germinate into seedlings, which will grow and develop into new healthy plants.

Exercise 11

Why dispersal is necessary

1. If fruits are not picked from the parent plant they may ..... to the ground and .....

2. The seedlings from the rotting fruits under the parent plant will not grow into healthy plants because they will be ..... and will ..... for water and .....

3. The large leaves and branches of the parent plant will keep the ..... from reaching the seedlings growing ..... it.

4. The process of scattering fruits and seed is called .....

5. Give three reasons why farmers and gardeners plant their seedlings at reasonable distances not only from the parent plants but also from each other?

Answers to Exercise 11

1. drop or fall and rot
2. overcrowded, compete, food
3. sunlight, below or under
4. dispersal of fruits and seeds
5. farmers space out seedlings to prevent overcrowding and competition for water, food and light.

Page 21

EXPERIMENT 8 : Investigating the dispersal of fruits and seeds in your collection

Your pupils will need:

their fruit collection
handlens

From their fruit collection, tell the pupils to make a simple key. Examples given will vary with locality.

From the puzzle picture exercise, agents or means of dispersal that come out are:

1. Animals
   (a) as external passengers, e.g. blackjack on clothing. (Draw blackjack fruit - pupils must examine blackjacks with their handlens.)
   (b) as internal passengers, e.g. guavas, berries and tomatoes.
2. Wind - if the seeds and fruits have extensions such as hairs or outgrowths, e.g. cotton, dandelion, etc. or wing-like extensions, e.g. on the pine, jacaranda and bouganvillea. Draw jacaranda seed.
3. Explosive fruits - these fruits have fruit walls which dry unequally. This causes them to twist and burst open (explode) with such force that the small and light seeds are thrown a great distance from the parent plant, e.g. jacaranda, acacia, bean, etc.

Try to make sure that your pupils examine as many different fruits and seeds as possible in Experiment 8. This will help them to recognise the different ways in which dispersal happens.

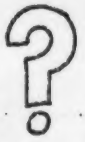
Your pupils may now copy and complete this table below in their notebooks. Local names may be used for identifying the different fruits and seeds.

Name of fruit or seed	Agent or means of dispersal	Adaptations or characteristics these fruits and seeds have to help them to be dispersed by a particular agent	Large labelled diagram of the named example
	Explosive	dries unequally, twists & bursts open, forcefully flinging the seeds away	
	Wind	(i) have hair outgrowth and very light seeds & fruit	
	Wind	(ii) have wing-like extensions & very light seeds & fruit	
	Animals	(i) as external passengers because the seeds & fruits have hooks and spikes	
	Animals	(ii) as internal passengers because the fruits are edible & the seeds so small they can be swallowed & go through the gut undigested	
	Water	fruit can float & fruit wall does not let water inside	

Set aside a whole lesson for pupils to read through their study guide and notebooks before answering 'How much do you know?'

Page 22

Answers to 'How much do you know?'



1. embryo
2. ovule, ovary
3. dispersal
4. seedling

BACKGROUND INFORMATION ON THE SUBJECT OF LIFE CYCLES FOR THE TEACHER

In your discussion with the class you may like to bring out these important points after your pupils have studied the various life cycle.

The main concept your pupils have learnt in E2 is that of the LIFE CYCLE. Some living organisms have a life cycle in which the adults produce male and female sex cells. These sex cells fuse and produce an embryo which develops into a new adult capable of producing sex cells in turn.

The discussion of the various life cycles, e.g. of mammals compared with birds, reptiles, fish, flowering plants, etc. shows that the duration, i.e. the period of time from one adult organism to the appearance of the next generation adult, varies from organism to organism.

However, in all these life cycles there is a point or stage at which the organism is most weak and can easily be damaged or destroyed. For example, in plants the young organism (seedling) is the weak stage where the plant needs a lot of care. In animals it is at the young cub stage when the child cannot take care of itself. In birds it is immediately after hatching before the young bird can also fend for itself.

These weak stages are used as points of attack in those organism which we want to get rid of without letting the young one have a chance to grow and reproduce itself. For example, it is easier to destroy the eggs and larvae of insects than the adults which can fly away from our baits, e.g. houseflies and mosquitoes. If weeds are controlled while they are still seedlings then we eliminate the chances of another generation of weeds being reproduced.

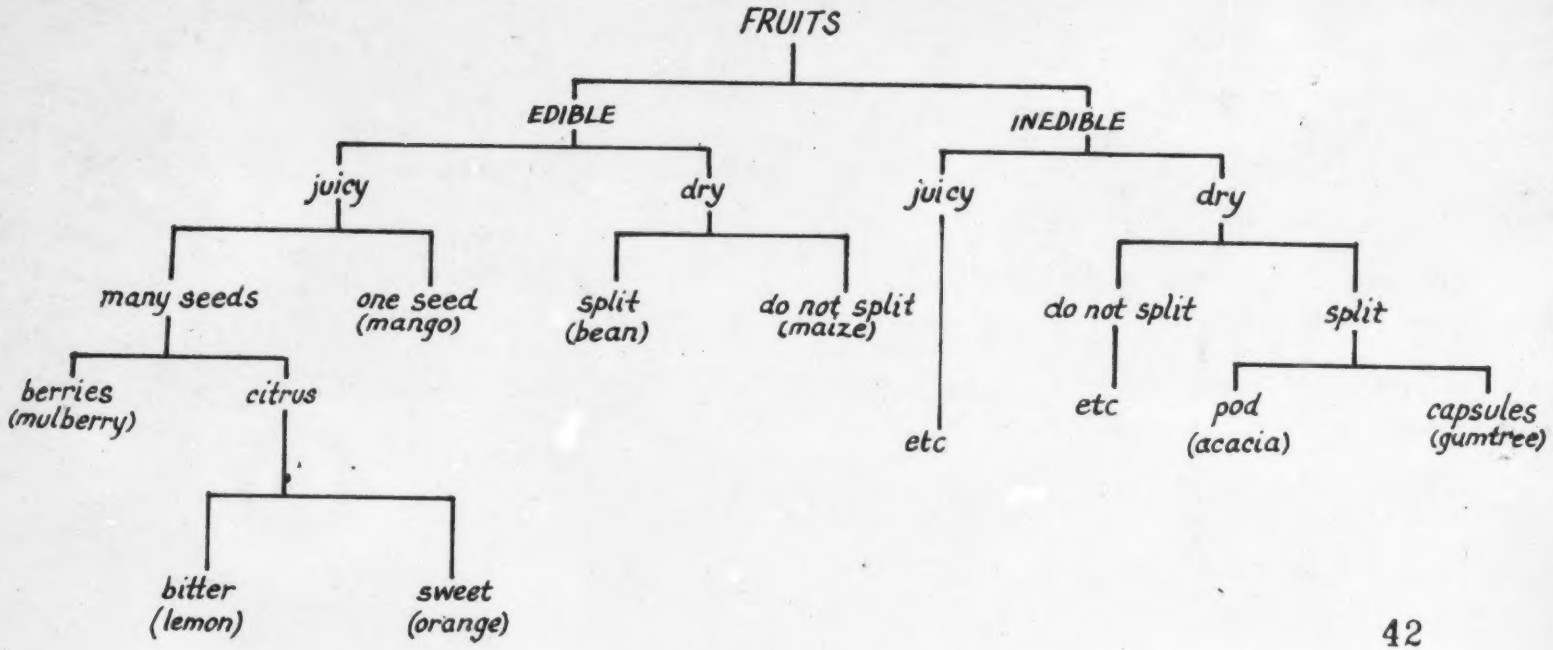
We do hope that your pupils have enjoyed learning how plants reproduce by flowers and seeds. Perhaps learning about cross-pollination as a way of getting varieties will stimulate the pupils to carry out some projects for the Young Scientists Exhibition!

We suggest you finish off this unit by giving the 'Aims of Unit E2' to the children as a test.

The Zim-Sci team would welcome your comments and constructive criticisms on this unit.

Printed by the Government Printer,
Salisbury

A KEY FOR FRUIT CLASSIFICATION



41

42